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Physics Procedia 33 (2012) 1133 – 1139

Physics Procedia

2012 International Conference on Medical Physics and Biomedical Engineering

Development of virtual Campus System Based on ArcGIS[1]

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Abstract

3D model of Multipach is just created by programming ArcObject or by loading models in other software, because it cannot be directly created by ArcGIS, but these two measures have their limitations. Taking Ningde Normal College as an example, the methods to establish virtual campus are studied based on 3D modelling, image processing and database, such as using 3D MAX to create 3D model and putting on the texture image, and redeveloping specific function by ArcGIS spacial analysis and C#, so as to perfect the function of the system. It provide more reliable guarantee for the campus planning and sustainable development.

Keywords : virtual reality. 3D Model. virtual Campus. ArcGIS.

1.Introduction

The model of virtual campus compiles with image, sound, text, video to create a vivid 3D campus, which is basis and platform of the digital campus to allow users to access "virtual reality" environment. Currently, most studies based on VRML, MultiGen-Creator, Java-3D has problems, which can not achieve deep levels of spatial analysis, such that a single building is not meticulous, or functions are limited to the reproduction of the scene and the conventional operation on general maps. Virtual technology base on GIS can combine the three-dimensional scene with spatial analysis to achieve dynamic three-dimensional roaming, query and analysis [1]. In this paper, a three-dimensional virtual system of Ningde normal university is built using ArcGIS9.2.

[1] This work was supported by the Natural Science Foundation of Fujian Province(2009J01294)

 doi:10.1016/j.phpro.2012.05.186

2.Establishment of a virtual surface on campus

2.1.Basic data acquisition

The main basis data for creating virtual campus includes the plane planning graphics of 1:500 (jpg format), high-resolution spatial imagery from Google Earth for free (Quick Bird data), height data of building and the surface features of the texture image data, and so on. The texture image is acquired by digital cameras to take photos of buildings, roads, grass, etc on campus. Due to various factors, these texture images can not be directly applied to the three-dimensional modeling, which must appropriately be processed to improve texture quality by Photoshop. The processed images can meet the need of the surface texture features[2].

2.2.Geographic data vectorization

Data digitization divided into the following steps:

1) Import the base maps: The campus planning maps import into ArcMap firstly.

*2) Raster and rectify:*The existing planning map data need to rectify because of lacking their geographic coordinates. Rectification is raster digital data to import into the system coordinate. This process can begin with setting the spatial reference image files for the coordinate of GCS-WGS-1984, and then use ArcGIS raster rectification tool bar, by adding control points. These control points require accurate and uniform in a map. Therefore, we selected two obvious points ---the North Gate and South Gate as control points, and then add the latitude and longitude to these control points, update the display, push the command of "rectify". We can make the raster image with a real geographic coordinates as a screen vector ground map. You can import high-resolution space imagery as a reference in rectification when happen some of the terrain distortion.

3) To create the elements layers: Base on the ruler of graphics and objects, combined with the practical needs of the virtual campus to create appropriate layers file in ArcCatalog.

4) Vectorization on screen: Adding layer file that created in the ArcCatalog to ArcMap, and activating the ArcScan extension toolbar, we can digitize layers by semi-automatic way of tracking respectively. Because digital geographic data must render in the format of three-dimensional display, so the number of the following points we need pay attention:

- All buildings are created in point format, building difference for the shape and structure or building difference orientation whether in same structure (for example, student apartment) should create in different layers.
- Just like trees, street lamps, billboards, vehicles, and others create in point's format, including them in different Orientation.
- But the venue, the lawn, the road as area format represent
- The railings, fences and other object as the form of the line.

2.3.To establish the properties of various elements dataset

In the follow-up, we must do the secondary development on querying in attribute, so we need establishment attribute datasets in their relevant elements. we also must establish fields just like "ID", "Height", "name" and other fields as shape files in ArcCatalog and then put them into ArcMap, and open all layers properties table to add attributes data.

3.Creation three-dimensional model

Three-dimensional landscape displays on ArcScene, mainly achievement by changing the data symbol (symbol selector) of the point, line and area data. ArcScene supports four kinds three-dimensional data format of *. 3ds, *. flt, *. skp, *. wrl. Here we choose 3D MAX to create three-dimensional modeling tool for three-dimensional landscape models on campus. The campus three-dimensional virtual model is divided into three categories: architectural models, terrain models, terrain models. in the common ground objects such as trees, poles, street lamps, we can use directly model that provide for the powerful three-dimensional data model library in ArcScene to create 3D-modeling. so we main only produce to building the complex geometries buildings modeling with 3D MAX tool[3].

3.1.The preparation of modeling

We observe construction of field buildings and reference the overall campus plan map to draw architectural Sketches, but the height and ratio of those buildings must match to the fact object.

3.2.Modeling process

Drawing model, rendering them with surface texture material and lighting effects[4].

3.3.Follow-up the modeling

After drawing the models, we export them as "* 3DS" format files to establish in their own style library and import them to a ArcScene. Output of this models must be carrying their surface texture material so they can be present actual in the ArcScene. Figure 1 is the model renderings of the library and office buildings that created by 3D MAX tool on the ArcScene.

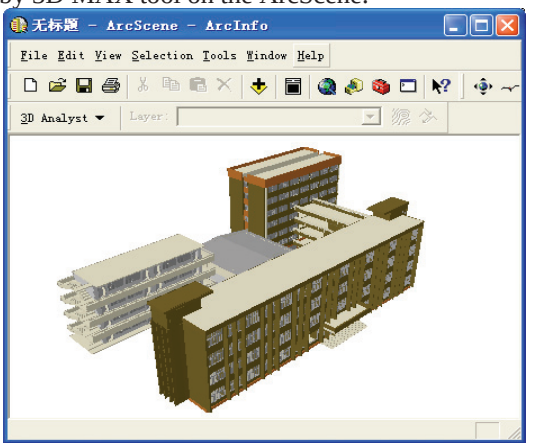

Figure 1 the model renderings of library and office buildings

4.Campus virtual system set up

We add layers in ArcScene and edit the layer properties. it is impossible to select different elements of the symbol in the same layer unless we give difference ID to all of the elements when we creating the property set. we select different elements symbols not only can choose them from the ESRI library but also from a custom "*. 3DS" format symbol file. We also can change symbolic in the size, direction and

coordinates, in particular, changes its direction correctly as same as actual in the ArcScene. Zoom in the whole scale of the symbols and let it to be visible after import model into ArcScene, at last, we don't forget to save the campus virtual system prototype in the ArcScene controls.

5.Development functions of the campus virtual system

The main form shows in Figure 2, the system user interface contains "SceneControl", "ToolbarControl", "TocControl", "Treeview" and other GIS controls. the system is created by pull-down menus, toolbars, the map window, the properties window, work space management form and navigation item,and so on. System provides many functions just like the layer management, scene display and navigation, data management and data output, the querying search and other functions, this meet the basic needs to campus planning and management, basically to achieve the scientific management of the campus with networking and intelligent [5].

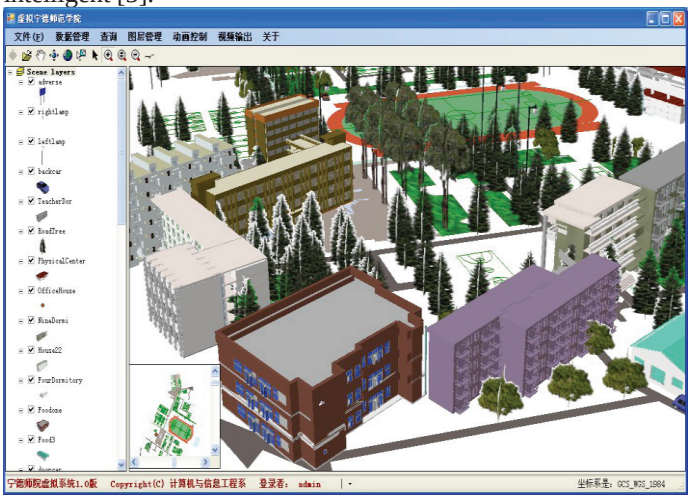

Figure 2 the overall effect diagram

Implementation of the system functions as follows:

5.1.Layer Management

We can easy let map layers for show, hide, add, delete and statistical by ArcGIS controls that connect to the database.

5.2.Scene display and navigation

Conventional operation contains zoom, move, rotate and others,It can fully show the status of geographic information on campus, including all types of buildings, pipelines spatial location, distribution and mutual relations, even the campus three-dimensional panorama as a whole. In addition, we can use navigation form, similar to the Eagle Eye, to locate the main map easily. That can quickly switch between the main map and the navigate form.

5.3.Data Management and Output

Raster data can be added to the Scene, It is easy to built Tin files and convert Tin files to Patch, it can output many kinds formats images, just like formats of *.jpg,*.tif, *.gif and so on. It can output as AVI video animation files also.

The key codes are as follows:

```
// The TIN is the key to convert MultiPatches use ITinSurface 2 interface
ConvertToMultiPatches method
            ESRI.ArcGIS.Carto.ITinLayer pTINLyr = new ESRI.ArcGIS.Carto.TinLayer();
            pTINLyr = AxSceneControl1.Scene.get_Layer(2) as ITinLayer;
            // First to create this layer
  ESRI.ArcGIS.Carto.IFeatureLayer pFeatureLyr = AxSceneControl1.Scene.get_Layer(3) as
IFeatureLayer;
            ESRI.ArcGIS.Geodatabase.IFeatureClass pFeatureClass = pFeatureLyr.FeatureClass;
            ESRI.ArcGIS.Geodatabase.ITinSurface2 pTinSurface2;
            pTinSurface2 = pTINLyr.Dataset as ITinSurface2;
            pTinSurface2.ConvertToMultiPatches(pFeatureClass, 100, 10);
```

5.4.Search &Query

Query including the condition querying and click querying[6], Because the system of spatial information and attribute information save in database that they can query, search or locate position quickly for the buildings or subsidiary Information accurately. Many kinds of spatial statistical and analysis provide accurate and detail data for buildings management, design and planning. this function is a two-way search and querying, either based on graphical can search its properties, or use properties can position to its graphics.

1) Querying attributes of buildings: Click on a floor of the building, It can display details properties information, including building name, number, floor, area, and other properties information. This functional implementation as follows:

- Use Iscenegraph interface Locate method to convert the screen position coordinates than the mouse click on into three-dimensional point coordinates;
- To return building objects that be clicked on;
- The selection object is passed to the properties windows to show its properties information.

For example click on the first canteen diagram to show detail properties in Figure 3:

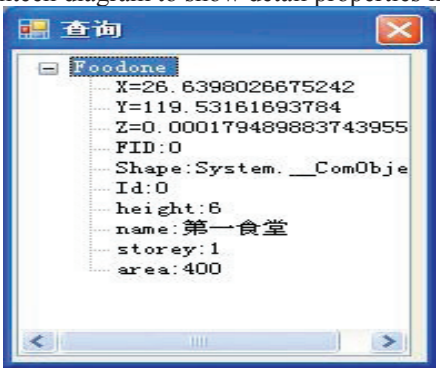

Figure 3 the first canteen properties

2) Location to the building according to the attribute field: For example, how to query a position of No.1 teacher house in Ningde normal university, first, we select the layer "teacher House" in the drop-down box item of "TeacherDor", and select “name” in querying fields, and then select “No.1 teacher house”, target object will be located at the "No.1 teacher house", and change its color for selection. The steps as follows:

- Create a querying filter, make it value with SQL language;
- Use select method of IfeatureClass to select elements that accords with the querying condition;
- These elements is displayed in the ArcSceneControl.

key code to realize is as follows:

```
switch (pField.Type)
            {
                case esriFieldType.esriFieldTypeString :
                    pQueryFilter.WhereClause = cmbFields.Text + "='" + txtValue.Text + "'";
                    break;
                case esriFieldType .esriFieldTypeDouble :
                case esriFieldType .esriFieldTypeInteger :
                case esriFieldType .esriFieldTypeSingle :
                case esriFieldType .esriFieldTypeSmallInteger :
                    pQueryFilter.WhereClause = cmbFields.Text + "=" + txtValue.Text;
                    break;
            }
            IFeatureCursor pFeatureCursor;
            pFeatureCursor = pFeatureLayer.FeatureClass.Search(pQueryFilter, false);
            IFeature pFeature;
            pFeature = pFeatureCursor.NextFeature();
            while (pFeature != null)
            {
                pScene.SelectFeature(pFeatureLayer, pFeature);
                pFeature = pFeatureCursor.NextFeature();
            }
            pActiveView.PartialRefresh(esriViewDrawPhase.esriViewGeoSelection, null, null);
```

5.5.Animation control

This part mainly develops functions on how to create key frame, a free key frame, the water level rising simulation, and how to control playback of the track and select different speed in automatic rotation, so we can further developed based on this functions[6].

6.Conclusion and prospect

Virtual campus is developing in domestic colleges and universities, which has played a positive role for campus planning, publicity and internal management. At the same time, the related theory and applied research of 3DGIS systems is carried out quickly, however, many profound problems have not been systematically and comprehensively solved. First, in 3D scene, the data size of the 3D will affect the rate to import ArcGIS model library. Second, today most of virtual environment mainly focused on lifelike reconstruction and multimedia demonstration, and lack of geographical spatial analysis, and the campus virtual in the university management about automation, scientific, networking and intelligent level is still not high. The most basic functions are realized, such as querying building, and the powerful functions

should be further developed [7-8]. Of course, there are some shortcomings for 3D MAX, which is lack of some advanced techniques compared to professional modelling software, such as LOD, MIPMAP, BSP, OCTREE, OCCLUSION, is bound to increase the amount of data. With the further development of computer technology and virtual technology, the 3D function of the virtual campus will be improved.

Acknowledgment

I want to thanks my Friend, Wei Zongwei. When I was in trouble, he always told me how to solve the problem. After I finished the project, he gave me some advices to modify my project. I also want to thanks my colleague who gave me encourage.

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